



Working Safely in the Cold

Division of Epidemiology, Environmental and Occupational Health

Cold is an occupational health hazard for many types of workers. Some jobs at risk are listed in the box below. At this time there is no specific regulation that addresses the protection of workers from environmental cold, although the Occupational Safety and Health Administration (OSHA) and the New Jersey Public Employees Occupational Safety and Health (PEOSH) General Duty Clauses may apply in severe cases. This publication presents an overview of the health hazards of working in cold environments and contains guidelines and resources on how workers can be protected.

Like all occupational diseases, cold-related health problems are under-recognized and under-reported. Relatively few employers report workers who died or missed work as a direct result of exposure to environmental cold. From 1992 to 1997, there was a total of 27 reports of occupational fatalities caused by the cold. In 1997, out of 1,833,380 cases of nonfatal injuries involving days away from work, only 244 reports were related to exposure to environmental cold and another 143 to contact with cold objects or substances. The existing data do not cover public employees, farms with less than 11 employees, or injuries that do not result in time lost from work. Finally, the data cannot reveal the indirect toll a cold environment may exact on exposed workers.

Direct cold-related health problems

Hypothermia: Hypothermia, a drop in the body's internal temperature below 95°F, is a threat in frigid weather but can also strike at moderate temperatures. It is a medical emergency with a high fatality rate.

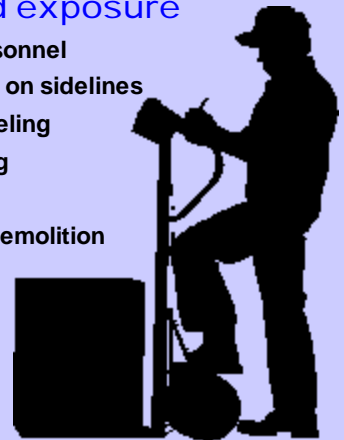
Frostbite: Skin, muscle, blood vessels, and nerves freeze and form ice crystals. Blood vessels become blocked with tissue debris that causes more damage. Frostbite is often irreversible and amputation is sometimes required. If the injured site heals, the victim may suffer chronic pain or numbness, excessive sweating, abnormal skin color, and joint pain. The feet, hands, ears, nose, cheeks, and penis are the most frequently injured sites.

Immersion foot: If part of the body is covered with water or wet mud that is just above freezing, the area may become chronically swollen, weak, and sensitive to the cold.

Chilblain: Red, swollen skin, usually on hands and feet, that feels hot, tender, and itchy after cold exposure.

Types of jobs at risk for cold exposure

- Airport ground personnel
- Athletes, especially on sidelines
- Auto Repair and Fueling
- Bus and Taxi Driving
- Cold Storage
- Construction and Demolition
- Dairy Farming
- Fishing and Diving
- Ice Making
- Logging
- Maritime
- Meat Packing, Fresh and Frozen Food
- Mining, Oil and Gas Drilling
- Police, Fire, and Emergency Responders
- Postal and Other Delivery
- Pulp and Paper
- Railroad and Trucking
- Road Repair
- Ski Resorts and other Outdoor Recreation
- Snow and Trash Removal
- Utility Repair
- Warehousing



Christine Todd Whitman
Governor

New Jersey Department of Health and Senior Services
Occupational Health Service
Occupational Health Surveillance Program
PO Box 360, Trenton, NJ 08625-0360
(609) 984-1863
www.state.nj.us/health/eoh/survweb/

Christine Grant, J.D., M.B.A.
Commissioner

Indirect cold-related health problems

Disease flare-ups: Conditions like arthritis and asthma can be made worse in cold environments.

Increase in injuries: Cold weather can decrease dexterity, mental skills, coordination, and cause a general decline in performance that affects safety.

Strains and sprains: Working in cold weather can increase the risk of injuries to muscles and tendons, for example, back strain.

Other health effects: Sinus irritation, viral infections, chronic lung disease, arthritis.

Factors that increase danger from the cold

Air movement: High wind exposure, strong ventilation, moving through air -- as in an open vehicle.

Wetness: Wet skin, clothing or shoes from being wet with water, gasoline, alcohol, solvent, or other liquid that evaporates.

Sweating: Wet skin, clothing or shoes from sweating.

Under-dressing: Exposed fingers, cheeks, nose, ears; uncovered head.

Over-dressing: Too-thick clothing rather than layers; tight-fitting belt, clothing or shoes that restrict circulation; waterproof clothing that restricts evaporation.

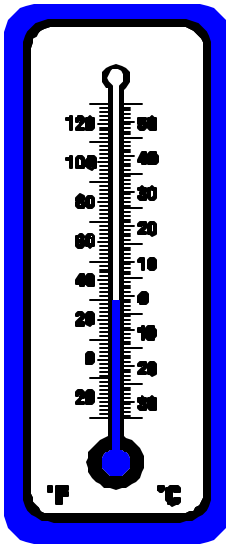
Low activity level: Standing or sitting still, driving.

Contact with cold objects: These take the heat out of the body.

Being tired, hungry or thirsty: These keep the body from replacing lost heat.

Medical conditions: Especially those affecting circulation, such as diabetes, an underactive thyroid, heart disease, history of frostbite.

Medications: Some medications such as tranquilizers and beta-blockers cause drowsiness or decrease vasoconstriction.



Alcohol, caffeine, nicotine: Alcohol impairs judgement and reduces shivering. Caffeine increases urine production and blood circulation; both lead to a loss of body heat. Nicotine decreases blood flow to the extremities and raises the risk of cold injury.

Control measures to prevent cold-related injuries

1. Keep Track of the Temperature and Air Movement and Link to an Action Program

Indoors: Readings of temperature and air movement should be taken in all cold work areas at the start, middle, and end of each shift, at least every four hours.

Outdoors: The weather report can be used.

Wind Chill Chart: Where there is air movement from wind, ventilation or travel in an open vehicle like a forklift, the wind chill index should be used to evaluate the hazard, rather than the air temperature. The wind chill index takes into account the wind blowing the heat away from the body. If you know the temperature and speed of air movement, the wind chill can be looked up in **Table 1**, page 7.

2. Raise the Temperature The first line of defense against cold is to warm things up. A refrigerated room can be kept at the maximum allowable temperature. Outdoor work can be postponed to a warmer day, using weather forecasts for planning. Warm air jets, radiant heaters, and contact warm plates can be provided for spot heating. Infrared radiant heaters warm people and objects but not the air and therefore may be cost-effective in warehouses, loading docks, and other large, unheated indoor spaces.

3. Use Warming Shelters Heated tents, cabins, break rooms, etc. should be available to workers. The colder the temperature and the higher the wind speed, the more often special warm-up breaks should be taken in these shelters. Breaks should be

KEROSENE HEATER WARNING

Kerosene heaters present a number of serious hazards -- fire or explosion, burns, carbon monoxide poisoning, and other toxic gases.

Never use a kerosene heater in a small, tightly closed room.

at least 20 minutes to allow for re-warming. The onset of heavy shivering, frostnip or minor frostbite, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the warming shelter. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended the work/warm up schedules in **Table 2**, page 7. For example, at -20 to -24 degrees Fahrenheit (°F) with a wind speed of five miles per hour (mph) [440 feet per minute (fpm)], the ACGIH recommends two warm up breaks in a 4-hour period, with a maximum work period of 75 minutes. Note that the table also gives several ACGIH recommendations on when non-emergency work should cease -- for example, below -35 °F with a 10-mph (880 fpm) wind speed.

4. Control Effects of Air Movement An increase of just one mph (88 fpm) in wind speed can double the chance of cold injury. Wind can be blocked by wind shields. In refrigerated rooms, air speed can be minimized as much as possible by properly designed air distribution systems and should not exceed 2.3 mph (200 fpm). Special wind-protective clothing can be provided.

5. Stay Dry Heavy sweating will result in wet clothing. The work rate should be fast enough to keep warm, but not so fast as to cause heavy sweating. Clothing that has become wet either from sweating, rain, snow, or other water source should be changed. When entering a heated shelter, snow or frost on clothing should be brushed off before it melts, the outer layer of clothing should be removed and the remainder of

the clothing loosened to permit sweat evaporation. Snow should be kept out of clothing, boots and gloves.

6. Wear Loose-fitting, Layered Protective Clothing

NOTE: Selection of cold weather protection should be done in compliance with OSHA and PEOSH standards on personal protective equipment (PPE). These are 1910.132 for general requirements, 1910.136 for foot protection, and 1910.138 for hand protection. A hazard assessment is a key requirement. There are separate PPE standards for construction, maritime, and agriculture. Resources on the PPE Standard are given at the end of this fact sheet.

**Three layers of body, hand,
foot, and head protection
should be used!**

Protection should be loose-fitting with at least three layers so as to trap air and provide insulation. At the same time, it is important that protection be permeable to perspiration. Only if very light work is involved should the outer layer of body protection be waterproof. Desirable features in cold weather clothing include hand-warmer pockets, hoods, Velcro® adjustable cuffs, removable linings, and easy control of openings at neck, underarms, and wrists to regulate ventilation of interior space.

Inner wicking layer: An inner layer of protection made of a wicking material, such as cotton or polypropylene, will help to draw moisture away from the skin.

Middle insulating layer: Wool, down, fleece or other material with loft will hold the body's heat without adding weight. Protective clothing has improved with the introduction of synthetic fabrics





that are lighter, more insulating, and faster-drying than wool, for example, polyester fleece like Polartec.®

Outer layer for wind and water protection: Water-repellent outer fabrics will let air pass

through them and can be changed as they become too wet. There are now waterproof fabrics that are also breathable, for example, Gore-Tex.® This layer may also need to be resistant to oil, fire, chemicals, or abrasion.

Hand protection: Protection of the hands is important not only to prevent injury but also to maintain dexterity and prevent accidents. Layer with glove liners, gloves, then mittens. For jobs requiring dexterity, there are fingerless gloves with attached mittens that can be temporarily folded back. The ACGIH recommends gloves if the air temperature falls below 60.8 °F for sedentary, 39.2 °F for light, and 19.4 °F for moderate work. If fine work



is to be performed with bare hands for more than 10-20 minutes, special provisions such as warm air jets, radiant heaters, or contact warm plates

should be made. Below 0 °F, the ACGIH recommends mittens which protect better than gloves. Machine controls and tools for use in cold conditions should be designed so they can be handled without removing the mittens. Metal handles

should be covered by thermal insulating material at temperatures below 30.2 °F. Warning signs should be placed on cold surfaces below 20 °F.

Foot protection: The feet and toes are highly susceptible to cold injury. Layer with sock liners, woolen or polyester socks, then waterproof insulated boots. Military vapor-barrier boots and Native Alaskan-inspired mukluk boots are models of good boots. Removable felt liners should be used in boots and



removed daily for complete drying. Socks should be changed if damp. Boots may need to have a steel-toe if crushing hazards are present. Tight-fitting shoes should be avoided because they restrict blood circulation and don't allow air to be trapped in socks for insulation.

Head and face protection: Hats, hoods, and masks not only prevent frostbite to the cheeks, ears and nose but also conserve heat loss from the head. Forty percent of heat loss is through the head. Removing headgear is an important way to decrease body temperature when overheated.



7. Have a Change of Clothing for an Emergency In case of wetting or excessive sweating, a complete change of clothing, shoes, hat, gloves, etc., should be available.

8. Eat and Drink Well Workers can prepare for work in the cold by eating a high calorie diet to maintain a larger reserve of stored energy. Dehydration or the loss of body fluids can be a problem

in the cold. Warm, sweet drinks, and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee, tea, cola, and alcohol should be limited.



▲
9. Use a Buddy System The ACGIH recommends that below 10.4 °F workers should be under constant protective observation by a co-worker or supervisor. New employees should not be required to work full-time in the cold during the first days on the job until they become accustomed to the working conditions and required protective clothing.

10. Prepare for Vehicle Breakdowns Workers who must travel in cold weather should be supplied with extra warm clothing, gloves, and blankets, as well as normal vehicle emergency supplies. ►

11. Worker Education Workers exposed to cold should receive initial and annual training regarding the health effects of cold exposure, proper re-warming procedures, recognition and first aid for frostbite and hypothermia, required protective clothing, proper use of warming shelters, the buddy system, vehicle breakdown procedures, and proper eating and drinking habits for working in the cold. *NOTE: The PPE Standard requires that employ-*

ers certify in writing that training on PPE use, care, and limitations has been provided and that employees understand what they have been taught.

12. Medical Checkups Workers should be checked by a physician to assure that they are not suffering from diseases or taking medications which interfere with normal body temperature regulation or reduce tolerance for cold environments.

13. Proper Medical Treatment *Treatment of cold-related health problems in a medical facility can make the difference between full recovery and lifelong problems.* **Treatment for frostbite** involves rapid rewarming of the affected parts in 104-108 °F water and oral and topical therapy to limit inflammation. **Treatment for hypothermia** involves whole body re-warming from the inside out, *not immersion or exercise.* Because internal organs, including the heart, are cold, people suffering from hypothermia are at increased risk of heart attacks. Helpful measures (until transport to a medical facility) include moving the worker to a warm, dry location, warm liquids, removing wet clothing, adding layers of dry clothing, placing the victim in a pre-warmed sleeping bag, preferably with a warm person, and heat packs in the armpits, neck, chest, and groin. *Severe hypothermia can mimic death. Victims should receive medical care even if they show no signs of life.*



Resources on Cold Safety

Weather Reports and Forecasts

- Local newspapers, TV and radio stations
- **National Weather Service**
www.nws.noaa.gov
- **The Weather Channel**
www.weather.com

Educational Materials

- **Protecting Workers in Cold Environments**, OSHA Fact Sheet, 12/22/98, free, www.osha.gov/OshDoc/Fact_data/FSNO98-55.html or call OSHA Publications, (202) 693-1888
- **Cold Weather Safety Guide**, CCOHS booklet, \$10.00, Canadian Center for Occupational Safety and Health
1-800-668-4284 or (905) 570-8094
e-mail: custserv@cchos.ca
- **Learn2 Avoid Frostbite**, on-line tutorial for the lay person
www.learn2.com

Articles and Reviews

- **Cold Environments and Cold Work**
Homer, I; Granberg, P; Dahlstrom, G
Encyclopedia of Occupational Health and Safety, Fourth Edition, 1998, 42.29-42.44
- **Cold Exposure Injuries: Prevention and Treatment**
Fritz, RL; Perrin, DH
Clin Sports Med, 1989, Jan; 8(1):11-28
- **Frostbite: Review and Current Concepts**
Reamy, BV
J Am Board Fam Pract, 1998, Jan-Feb; 11(1):34-40
- **Work in the Cold. Review of Methods for Assessment of Cold Exposure**
Holmer, I
Int Arch Occup Envir Health, 1993; 65(3):147-55

Exposure Limits

- **Thermal Stress, Cold Stress**, 1999
TLVs® and BEIs®, pages 159-167,
ACGIH, (513) 742-2020, \$19.50
e-mail: customerservice@acgi.org
www.acgi.org

Cold Weather Clothing, Shoes, Gloves

- Yellow Pages under "Safety Equipment and Clothing"
- Camping and Outdoor Stores, Department Stores
- Thomas Register, directory of vendors available in many libraries and on-line at: www.thomasregister.com
- On-line Buyer's Guides for Health and Safety equipment:
www.ohsonline.com
www.ohinteractive.com

OSHA/PEOSH Personal Protective Equipment Standard

- **Personal Protective Equipment**, OSHA Publication 3077, 1998, free, call OSHA Publications, (202) 693-1888
- **Assessing the Need for Personal Protective Equipment: A Guide for Small Business Employers**, OSHA Publication 3152, \$4.25, call U.S. Gov't Printing Office, (202) 512-1800
www.gpo.gov/
- **Assessing the Need for Personal Protective Equipment**, April 1999, OSHA Office of Training and Education. A set of training materials that includes a slide presentation and various checklists to help employers. May be borrowed from OSHA Area Offices, OSHA consultation, or purchased from NTIS, 5285 Port Royal Rd., Springfield, VA 22161
1-800-553-NTIS or (703) 605-6000
e-mail: orders@fedworld.gov
www.ntis.gov
Order AVA20431KKOO, \$140.00

Table 1
Wind Chill Index

Wind speed (mph)	Actual Thermometer Reading in Degrees Fahrenheit (F)								
	50	40	30	20	10	0	-10	-20	-30
	Equivalent Chill Temperature (F)								
0	50	40	30	20	10	0	-10	-20	-30
5	48	37	27	16	6	-5	-15	-26	-36
10	40	28	16	4	-9	-24	-33	-46	-58
15	36	22	9	-5	-18	-32	-45	-58	-72
20	32	18	4	-10	-25	-39	-53	-67	-82
25	30	16	0	-15	-29	-44	-59	-74	-88
30	28	13	-2	-18	-33	-48	-63	-79	-94
35	27	11	-4	-20	-35	-51	-67	-82	-98
40	26	10	-6	-21	-37	-53	-69	-85	-100
over 40 - little added effect	Little danger for properly clothed person if less than one hour exposure with dry skin.				Danger. Exposed flesh may freeze within one minute.			Great danger. Exposed flesh may freeze within 30 seconds.	
Immersion foot may occur at any point on this table.									

Table 2
Work/warm-up Schedule for 4-hour Shift Working in the Cold

Air Temp.	No wind		5 mph wind		10 mph wind		15 mph wind		20 mph wind	
Degrees Fahrenheit (°F)	max. work period	# of breaks	max. work period	# of breaks	max. work period	# of breaks	max. work period	# of breaks	max. work period	# of breaks
-15 to 19 °F	(normal breaks) 1		(normal breaks) 1		75 min.	2	55 min.	3	40 min.	4
-20 to -24 °F	(normal breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-25 to -29 °F	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
-30 to -34 °F	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-35 to -39 °F	40 min.	4	30 min.	5	Non-emergency work should cease		Non-emergency work should cease			
-40 to -44 °F	30 min.	5	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease			
-45°F and below	Non-emergency work should cease									

Table applies only if workers are wearing dry clothing and doing moderate to heavy work activity. For light to moderate work activity, move down one line to decrease maximum work period and increase the number of breaks.

Source: Thermal Stress, Cold Stress, 1999 TLVs® and BEIs®, pages 159-167, ACGIH, Cincinnati, OH

